

UNITED STATES MARINE CORPS

LESSON PLAN

SOURCE REGIONS

INTRODUCTION:

1. Gain Attention. Have you ever heard forecasters talk about tropical or polar air masses, well if you have or not in this class you are going to learn about them.

2. Overview. During this period of instruction, the student(s) shall be introduced to the different types of source regions and the air masses that are associated with them.

3. Introduce Learning Objectives.

a. Terminal Learning Objective. Without the aid of references, but in accordance with this period of instruction, the student(s) shall use a world map to identify five (5) areas that are favorable for source regions with no assists from the instructor.

b. Enabling Learning Objective(s). Without the aid of references,

(1) State the criterion that must be obtained to meet the requirements to be considered a source region.

(2) Explain why mid-latitudes are not favorable areas for source regions.

(3) State the location of source regions and the characteristics of the respective air masses that affect the United States.

4. Method/Media. This period of instruction will be taught using the lecture method with the aid of a Macromedia Flash presentation "QMMPH1-Introduction to the Earth's Dynamics".

5. Evaluation. The student(s) shall be evaluated by physically and successfully completing the terminal learning objective.

TRANSITION. Recall from previous discussions (QMMPH1-041) the definition and characteristics of air masses. The next topic focuses on where air mass originate.

BODY:

1. Defining a Source Region. Certain parts of the Earth's surface are particularly well suited for the formation of air masses. These areas must be extensive in size, contain physically uniformity, and associated with stationary anticyclonic air. The areas that meet this criterion are called *source regions* and considered the birthplace for air masses. Ideal source regions are ocean surfaces and extensive flat land areas that have a uniform covering (plains, forest, snow, or deserts).

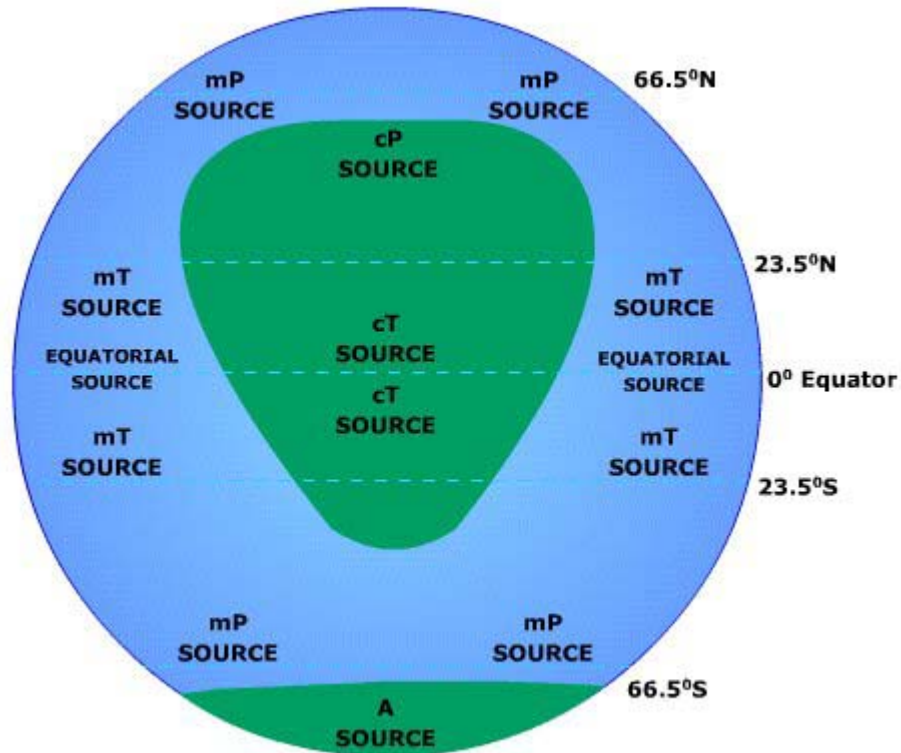


Figure 1 - A global model that shows typical locations favorable for air mass formation.

2. Formation of Source Regions. The atmosphere is chiefly heated from below and gains its moisture through evaporation from the surface of the Earth. Because of this, the nature of the source region largely determines the characteristics of the air mass(es).

a. It was previously stated that source regions must be large, physically uniform areas. A region that contains high irregularities, such as mountains or a surface containing both land and water, do not meet this criterion.

b. It was also stated that the area be "stationary". A general stagnation of the air must exist, so that the air will stay over the region long enough to acquire and maintain its characteristics.

(1) High pressure systems, with their centers being dominated by subsidence and weak pressure gradients, allow for light and variable surface winds which do not destroy the properties of the individual air mass allowing it to maintain its homogenous temperature and moisture characteristics.

(2) Low-pressure systems are not generally favorable to the formation of a source region because of their converging surface winds. The low-level convergence is consistently

bringing in air with different temperature and moisture values. Most synoptic scale low-pressure systems are frequently associated with some type of movement. This movement cannot allow the area of lower pressure to eliminate the differences in temperature and moisture. It results in a steep temperature gradient, vice a uniform one, and therefore air mass formation cannot take place.

TRANSITION. Certain circumstances allow for favorable areas for source regions and some do not. The next topic discusses where the most favorable areas for source regions may be located.

3. Favorable Locations for Source Regions.

- a. High polar latitudes and the subtropics around 30 degrees latitude are both good source regions, whose relative strength increases and decreases with the change of the seasons.
- b. Open ocean expanses, large deserts and extensive continental plains at high or low latitudes are the ideal birthing grounds within these belts.
- c. Mountainous areas are too variable in their properties, and mid-latitude continental plains are not conducive to air masses staying in place for long because of the strength of the prevailing westerly global winds at these latitudes.
- d. Mid-latitude oceans can be source regions under certain conditions because their surfaces have very uniform characteristics.

TRANSITION. The next topic focuses on the tie-in between source regions and the respective air masses that they produce.

4. Source Regions and Characteristics of Air Masses. From the characteristic properties picked up in their birthplace (some say *breeding ground*), air masses are designated as *hot* or *cold*, *wet* or *dry*. The terms are used to some relative degree.

- a. A *cold* air mass in summer may be as warm as a warm air mass in winter. Each air mass has a characteristic temperature and moisture content and thus we can distinguish four combinations: hot and dry; hot and wet; cold and wet; and cold and dry. Bergeron actually gave us two additional temperature categories by defining "very hot" and "frigid" air masses for those forming over the equator and Polar Regions, respectively.
- b. *Wet* air masses are considered to be air masses forming over the oceans, and *dry* air masses, those forming over the continents. Equatorial air masses are all considered to be *wet* because much of the land area under the equatorial zone is covered in tropical rainforests that can add as much moisture to the air as the equatorial oceans. All arctic (or Antarctic in the Southern Hemisphere) are considered *dry* because there is little evaporation into them from the frigid polar oceans and their temperatures are so low that even at saturation, the absolute humidity is very low.

Air mass source regions range from extensive snow covered polar areas to deserts to tropical oceans.

c. The United States is not a favorable source region because of the relatively frequent passage of weather disturbances that disrupt any opportunity for an air mass to stagnate and take on the properties of the underlying region.

(1) The principal air masses that influence the continental limits of the United States are the arctic, polar, and tropical.

(2) The arctic air mass brings the most frigid temperatures. An arctic outbreak that spreads southward across the Canadian border can bring record-breaking cold temperatures to the nation. Clear skies, extremely low humidity, and high atmospheric pressure prevail. The portions of the country most frequently affected by this air mass are the states between the Cascade and Sierra Nevada Mountains and New England. On occasion, even the Gulf Coast is touched by the icy finger of an arctic air mass. As much as two thirds of the nation can be affected by the bitter cold. Arctic air masses are responsible for bringing below zero weather to every state in the Union including Florida.

(3) Polar air masses formed over Canada and the Gulf of Alaska are common wintertime intruders of the continental limits. They are similar in the crisp dry cold-air that accompanies it, but not as bitterly cold as the arctic air mass.

(4) The Gulf Coast states and the eastern third of the country commonly experience the tropical air mass in the summer. At times during the winter months, tropical air masses form between California and Hawaii and drift eastward to affect West Coast weather.

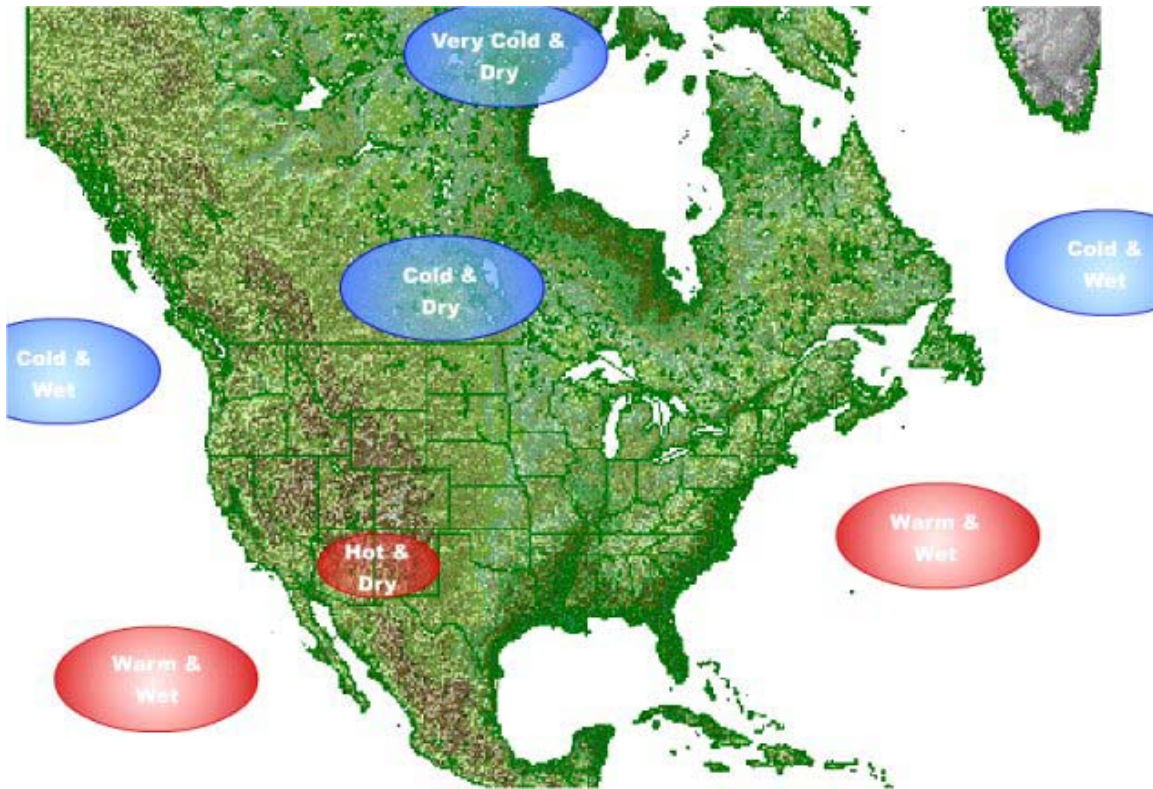


Figure 2 - Temperature and moisture characteristics of air masses.

OPPORTUNITY FOR QUESTIONS:

1. Questions from the Class. At this time, are there any questions pertaining to the information that has just been presented to you?
2. Questions to the Class. There are no questions for the student(s) and this time.

SUMMARY: During this period of instruction, the student(s) were instructed on what composes a source region, favorable areas that source regions might have a tendency to develop in, and the relationship between source regions and the characteristic of air masses.

REFERENCE.

Frederick K. Lutgens and Edward J. Tarbuck. The Atmosphere: An Introduction to Meteorology 9th ed. New Jersey: Pearson Education Inc., 2004.

Air Masses and Fronts. Naval Meteorology and Oceanographic Command. Last update 8/5/2004. Last accessed 8/7/2004.
<http://pao.cnmoc.navy.mil/pao/Educate/WeatherTalk2/indexairmasse.htm>